Vol. 17, No. 4 PSYCHOLOGICAL REVIEW PUBLICATIONS April, 1920

Psychological Bulletin

CONTENTS

PUBLISHED MONTHLY BY THE
PSYCHOLOGICAL REVIEW COMPANY
41 NORTH QUEEN ST., LANCASTER, PA.,
AND PRINCETON, N. J.

Agents: G. E. STECHERT & CO., London (2 Star Yard, Carey St., W. C.); Paris (16, rue de Condé)

Entered as second-class matter January 21, 1904, at the post-office at Lancaster, Pa., under Act of Congress of March 3, 1879

Psychological Review Publications

EDITED BY

HOWARD C. WARREN, Princeton University (*Review*)
JOHN B. WATSON, Johns Hopkins University (*J. of Exp. Psych.*)
JAMES R. ANGELL, 522 5th Ave., New York (*Monographs*)
SHEPHERD I. FRANZ, Govt. Hosp. for Insane (*Bulletin*)
MADISON BENTLEY, University of Illinois (*Index*)

WITH THE CO-OPERATION OF
MANY DISTINGUISHED PSYCHOLOGISTS

PSYCHOLOGICAL REVIEW

containing original contributions only, appears bimonthly, January, March, May, July, September, and November, the six numbers comprising a volume of about 480 pages.

PSYCHOLOGICAL BULLETIN

containing critical reviews, notices of books and articles, psychological news and notes, university notices, and announcements, appears monthly, the annual volume comprising about 480 pages. Special issues of the Bulletin consist of general reviews of recent work in some department of psychology.

JOURNAL OF EXPERIMENTAL PSYCHOLOGY

containing original contributions of an experimental character, appears bimonthly, February, April, June, August, October, and December, the six numbers comprising a volume of about 480 pages.

PSYCHOLOGICAL INDEX

is a compendious bibliography of books, monographs, and articles upon psychological and cognate topics that have appeared during the year. The Index is issued annually in May, and may be subscribed for in connection with the periodicals above, or purchased separately.

ANNUAL SUBSCRIPTION RATES

Review and Bulletin: $6 (Foreign $6.50). **Journal:** $3.25 (Foreign $3.50).
Review and Journal: $6 (Foreign $6.50). **Bulletin:** $3.25 (Foreign $3.50).
Journal and Bulletin: $6 (Foreign $6.50).
Review, Bulletin and Journal: $9 (Foreign $9.75).
Index with any other two: $7 (Foreign $7.50).
Review, Bulletin, Journal and Index: $10 (Foreign $10.75).
Current Numbers: Review, 65c; **Bulletin,** 35c; **Journal,** 65c; **Index,** $1.25.

PSYCHOLOGICAL MONOGRAPHS

consist of longer researches or treatises or collections of laboratory studies which it is important to publish promptly and as units. The price of single numbers varies according to their size. The Monographs appear at irregular intervals and are gathered into volumes of about 500 pages with a uniform subscription price of $5.50. (Postal Union $5.80.)

Philosophical Monographs: a series of treatises more philosophical in character.
Library of Genetic Science and Philosophy: a series of bound volumes.

Subscriptions, orders, and business communications may be sent direct to the

---

PSYCHOLOGICAL REVIEW COMPANY
PRINCETON, NEW JERSEY

Foreign Agents: G. E. Stechert & Co., London (2 Star Yark, Cary St., W. C.)
Paris (16, rue de Condé).

Vol. 17, No. 4 April, 1920

THE

PSYCHOLOGICAL BULLETIN

GENERAL REVIEWS AND SUMMARIES

CUTANEOUS AND KINESTHETIC SENSES

BY JOHN T. METCALF

Depart. of Public Welfare, State of Illinois

In the field of cutaneous sensation the literature of the past three years includes one study of pressure sensations, one of heat, and one of pain. The first, that of Schulte (17), has to do with the effect upon one pressure sensation of another aroused at the same time. Three mechanically applied and electrically controlled stimuli were used. They were applied to the backs of the index and middle fingers of the subject's right hand. One, the standard stimulus, was constant in intensity at 125 g., and in its duration of 0.5 sec. A second, the inducing stimulus, was taken at three intensities, 25 g., 100 g., and 175 g. A third, the comparison stimulus, was varied in intensity until it appeared equal to the standard. It was always 0.5 sec. in duration, and followed the standard with an interval of 0.5 sec. between the removal of the latter and its own application. The moment of application of the inducing stimulus was varied from 2.0 sec. before the application of the standard to simultaneous application with it. It was not removed until after the subject's judgment had been made. The effect of the inducing stimulus was found to be nearly always one of summation, and this effect was progressively greater with greater intensities of the inducing stimulus. It was greatest when the inducing stimulus was applied simultaneously with the standard, and decreased when the application of the inducing stimulus came sooner than that of the standard. Attention to the inducing stimulus increased its effect. In a theoretical discussion the author purposely leaves aside physiological concepts of summation and interprets his results on the basis of apperceptive complexes.

Cutolo (8) attacks the problem of whether or not heat is aroused by a simultaneous stimulation of warm and cold spots. His experiments consist of two series. In the first the Zimmermann thermesthesiometer was used to stimulate simultaneously with their appropriate stimuli a cold spot and a warm. The distance between the stimulated spots varied from 2 mm. to 9.3 mm., and the period of stimulation was usually 5 sec. The resulting experience was found to be very complex. Heat is reported in the majority of observations, and it is described by such terms as "sting" and "smack." In the second series of experiments a grill was used consisting of eight small glass tibes laid closely side by side. Warm water was run through the even and cold water through the odd numbered tubes. The subject laid his forearm or hand on the grill, the warm water was turned on until warmth was reported, and then the cold water was turned on. The apparatus is found to demonstrate clearly the arousal of heat sensations by the simultaneous application of warm and cold stimuli. The author also finds that heat may mix with other qualities. The question of whether or not heat may appear without the quality of pain he regards as still unsettled.

Adaptation to superficial pain is studied by Strauss and Uhlmann (18). Localized pain spots on the volar surface of the forearm were stimulated with hairs and bristles and by a needle fastened to the shaft of a Head algesimeter. Different intensities of stimulation were used. The stimulus was applied and held while the subject observed the course of the sensation. The writers served alternately as subject and experimenter. Adaptation to pain was found with great regularity. The results show large individual differences, but for both observers the time required for adaptation increases progressively with increase in the intensity of the stimulus.

Binnefeld (6) makes a study of kinesthetic sensations from the muscles of the eyes in the comparison of visual extents. Preliminary experiments were made in the light by comparing pairs of lines or unfilled spaces bounded by points. Further experiments were made in the dark-room with points of light. All experiments were made both monocularly and binocularly. Three arrangements were used. First, the subject followed a single moving point which traversed a given extent. Second, the subject fixated a stationary point while the moving point, starting from the stationary point, traversed a given extent as before. Third, the extents were presented by two points which lit up simultaneously. As measured by the difference threshold, the estimation of extent is of about the

same accuracy under all three of these conditions. This the writer takes to indicate a high degree of importance for kinesthetic sensations in the visual estimation of extents. It is also found that the accuracy of judgment of extent with the free-moving single point is not influenced by the duration of the movement. Goerrig (9) uses the Störring kinematometer and records the time of horizontal active and passive arm movements with the Hipp chronoscope. He finds that the estimation of the extent of the movements is not immediately dependent upon the perception of their duration, and that with both great and small extents the influence of the duration upon the accuracy of judgement is very small. He finds also that the extents are usually overestimated, an effect which tends to disappear with practice.

An article by Lashley (14) seems to the reviewer to be of great significance for work in the field of kinesthesia. It is a report of a study of the accuracy of voluntary movement in a case in which, owing to an injury to the spinal cord, the structures involved in making the movement were completely anesthetic. Although the subject experienced no sensation from the moving limb, the accuracy with which it was moved a prescribed distance without the aid of vision was not significantly less than that found in a normal subject.

Burtt (7) has made a careful study of the perception of slight changes of equilibrium. The subject sat in a chair on a platform so arranged that it could be tilted at a known rate to either side, forward, or backward. He was instructed to react with the appropriate one of two keys as soon as he perceived the direction in which he was being tilted. Two different rates were used, both relatively slow. Of 21 series 18 show a superiority in the detection of lateral over longitudinal movements, with an average superiority of 25 per cent. The apparatus was also arranged so that the platform could be lowered on one side 3 cm. in 150 σ with a negative acceleration. T he results show an average difference of 10 per cent in favor of lateral movement. A further study is made of the comparative advantages of dep and stick controls. The standard controls were duplicated in the laboratory, and experiments were made in much the same manner as the foregoing, except that now the subject reacted to the tilt with the control instead of with a key. There seemed to be no advantage of one form of control over the other when the force necessary to move them was the same.

Aimé (1) describes a case of labyrinthine disturbance, the result

of a gun-shot wound, in which the patient was unable to make movements in the vertical direction. When he attempted to climb a ladder, for example, he experienced extreme bodily discomfort. In connection with his study of this case the author raises the question whether there is a special sense of height, concluding that there is no more reason to assume this than there is to assume that there is a special sense of space. The functions of the different structures of the internal ear are also discussed by Bard (2). He suggests that there exists a close similarity between the mediation of tones by the tympanic membrane and the mediation of rhythmic movements by the elastic membranes of the labyrinth. Rhythms, he suggests, like tones may be harmonious or discordant, and there is nothing absurd in supposing that they may be combined into a system quite analogous to music. He points out that just as there are certain reflex accommodations in vision and audition, so also are there reflex accommodations of the static senses. These reflexes, the purpose of which is to enable the sense organs to function as perfectly as possible, form the subject of another paper (3). The same author contributes also a study of the physiological conditions of caloric nystagmus (4). This phenomenon he interprets as a double reflex, in part cerebral and in part cerebellar. The interplay of the two components results in the oscillatory movements of the eyes. Prince (16) has made a study of the effects of rotation and of unilateral labyrinth extirpation in kittens ranging in age from six days to seven weeks. The reactions show progressive changes with increased age. Well-defined labyrinthine disturbance is not found until about the third week after birth.

Equilibrium and Vertigo, by I. H. Jones (10) is a comprehensive summary of the anatomy, physiology, and pathology of the internal ear. The book is intended primarily for the medical practitioner and it contains much clinical material. It takes up at some length the practical uses of a study of the static senses with chapters on aviation and on seasickness. Many constructive suggestions are offered on the use of tests of the internal ear in diagnosis.

Also of interest primarily to the clinician are two articles which have appeared on the so-called "vibratory sensation," *i.e.*, the complex of sense qualities which is aroused when the foot of a vibrating tuning-fork is placed in contact with some subcutaneous bony prominence. Williamson (20) discusses the use of a stimulus of this sort in the diagnosis of certain affections of the spinal cord and peripheral nerves. Symns (19) describes a method of standardizing the examination of cases.

May and Larson (15) use Kalischer's training method with dogs for the purpose of studying the mediation of kinesthetic impulses in the cord. The dogs were trained to take meat only when the right hind leg was held rigidly extended backward. Then the cord was hemisected, at different levels in different dogs. It was found that the dogs' ability to react correctly to the posture tests was unimpaired. The experimenters therefore conclude that some of the fibers mediating kinesthetic impulses decussate within the cord.

Benussi (5) has published the report of an extensive continuation of his thorough work on apparent movement in the cutaneous sphere. The paper does not lend itself to summarization and reference must be made to the original for an appreciation of the many refinements of technique and of the numerous particular results. Tactual illusions are described in two brief notes by Krass (12, 13), and Kollarits (11) gives an account of his observation of a combined tactual and auditory one.

References

1. Aimé, H. Y a-t-il un sens de la hauteur? *Rev. phil.*, 1918, **86**, 136–141.
2. Bard, L. De la perception des mouvements et de leurs formes par le sens de la gyration. *J. de Physiol. et de Pathol. Gen.*, 1919, **18**, 70–82.
3. Bard, L. Des réflexes gyratifs. (Réflexes d'adaptation et d'accommodation du sens de la gyration.) *J. de Physiol. et de Pathol. Gen.*, 1919, **18**, 83–94.
4. Bard, L. Du rôle des centres nerveux dans la production du nystagmus thermique. *J. de Physiol. et de Pathol. Gen.*, 1918, **17**, 788–806.
5. Benussi, V. Versuche zur Analyse taktil erweckter Scheinbewegungen (kinematohaptischer Erscheinungen) nach ihren äusseren Bedingungen und ihren Beziehungen zu den parallelen optischen Phänomenen. *Arch. f. d. ges. Psychol.*, 1917, **36**, 59–135.
6. Binnefeld, M. Experimentelle Untersuchungen über die Bedeutung der Bewegungsempfindungen des Auges bei Vergleichung von Streckengrössen im Hellen und im Dunkeln. *Arch. f. d. ges. Psychol.*, 1918, **37**, 129–232.
7. Burtt, H. E. The Perception of Slight Changes of Equilibrium, with Especial Reference to Problems of Aviation. *J. of Appl. Psychol.*, 1918, **2**, 101–115.
8. Cutolo, F. A Preliminary Study of the Psychology of Heat. *Amer. J. of Psychol.*, 1918, **29**, 442–448.
9. Goerrig, M. A. Über den Einfluss der Zeitdauer auf die Grössenschätzung von Armbewegungen. *Arch. f. d. ges. Psychol.*, 1917, **36**, 293–358.
10. Jones, I. H. *Equilibrium and Vertigo.* Philadelphia: Lippincott, 1918. Pp. xv + 444.
11. Kollarits, J. Über eine taktile und akustische Täuschung. *Arch. f. d. ges. Psychol.*, 1918, **37**, 403.
12. Krass. Über eine neue Tasttäuschung. *Arch. f. d. ges. Psychol.*, 1918, **37**, 300.
13. Krass. Über eine neue Tasttäuschung. *Arch. f. d. ges. Psychol.*, 1918, **37**, 402.

14. Lashley, K. S. The Accuracy of Movement in the Absence of Excitation from the Moving Organ. *Amer. J. of Physiol.*, 1917, **43**, 169–194.
15. May, E. S. & Larson, J. A. Posture-sense Conduction Paths in the Spinal Cord. *Amer. J. of Physiol.*, 1919, **50**, 204–207.
16. Prince, A. L. The Effect of Rotation and of Unilateral Removal of the Otic Labyrinth on the Equilibrium and Ocular Reactions in Kittens. *Amer. J. of Physiol.*, 1917, **42**, 308–317.
17. Schulte, R. W. Die gegenseitige Beeinflussung von Druckempfindungen. *Psychol. Stud.*, 1917, **10**, 339–380.
18. Strauss, H. H. & Uhlmann, R. F. Adaptation of Superficial Pain. *Amer. J. of Psychol.*, 1919, **30**, 422–424.
19. Symns, J. L. M. A Method of Estimating the Vibratory Sensation. *Lancet*, 1918, **194**, 217–218.
20. Williamson, R. T. The Vibrating Sensation in the Differential Diagnosis of Affections of the Spinal Cord and Peripheral Nerves. *Lancet*, 1918, **194**, 216–217.

AFFECTIVE PHENOMENA—DESCRIPTIVE AND THEORETICAL

BY H. N. GARDINER

Smith College

Distinguishing pleasure and the consciousness of pleasure Wallis (**16**, **17**), in the interest of ethics, seeks an objective criterion to determine its true nature. He finds this in the definition of pleasure as the doing of a thing for its own sake. True pleasure, then, is that pleasure which is included in the fulfilment of life purposes. Drake (**2**) criticizes the "behavioristic" definition as a twisting of terms, contends that pleasure, as quality, is just what it is experienced as being, and finds the new meaning ethically valueless. Curiously neither writer refers to Plato's classical discussion of this subject. That the doctrine of pleasure as feeding varying only in intensity does not justify hedonism, is clearly shown by Ward (**18**). Rogers (**12**), accepting the view that pleasure is a sign that the demands of our nature are being met and also that pleasure is the reason why the end of an action is judged good, finds, nevertheless, that for ethical judgment the satisfaction of the moment must be brought into relation with the reflective idea of the satisfaction of life as a whole.

On the general subject of emotion the article by Larguier des Bancels (**7**) is serviceable for orientation. Defining emotions as affective commotions and instincts as species of adapted acts, he divides emotions into those that merely accompany and translate the instinct in terms of consciousness and those that are either

general, like grief and joy, or special, like anger and fear. The latter, though based on instinct, express its frustration; but, as there are all sorts of transitions between an instinct that succeeds and one that fails, there is no discontinuity between instinct and emotion. Carver (1) relates emotion and instinct more precisely. Emotion is defined as "the subjective experience which develops when gratification of the instinctive impulse is held in check by higher level control." It reinforces the "interest" of the instinct. If satisfaction is checked, tension arises and the affective element is experienced as emotion; if satisfaction is persistently thwarted, the condition becomes psychoneurotic. Illustrations are found in war neuroses. One important conclusion is that the energy of an instinctive process can find outlet along psychically equivalent paths, the problem being to find and inculcate useful psychical equivalents. T. A. Williams (23) and F. E. Willians (22) also treat of war neuroses, the former discursively, laying general emphasis on methods of psychotherapy, the latter explaining more particularly that anxiety and fear arise from "conflict," the complete or partial disability to adapt to the complex conditions of modern life. Spaulding (14) refers to "conflict" three cases of larceny, "conflict" here apparently meaning emotional repression, or the failure of unfulfilled desire.

An able article, full of matter, from the behavioristic standpoint, is contributed by Watson (21), who defines emotion as "an hereditary pattern-reaction involving profound changes of the bodily mechanism," particularly visceral and glandular. By "pattern-reaction" is meant a response the details of which appear with some constancy, regularity and order of succession each time the exciting stimulus is presented. Emotional reaction is distinguished from instinctive by the initial disturbance aroused by the shock of the stimulus; but the distinction is not absolute. Environmental conditions have probably brought about the partial inhibition of the more primitive types of emotion, while the glandular and smooth muscle sides remain; this would explain changes in level, the reinforcement or inhibition of emotions in progress and the finding of new outlets. The only primitive emotions which the author discovered in his experimental observation of young children were fear, rage and love, the last in approximately the Freudian sense of sex. The explicit portions of the reaction in emotion being usually the least important, he proceeds to consider the various methods for detecting the implicit. They include the controlled

association word reaction, the free association method, dream study and analysis (surely not wholly without introspection!), and several others in which he finds value, while he attaches little or no value at present to "expressive" methods and the so-called psychogalvanic reflex. He further discusses substitution of stimulus, attachments and detachments, emotional outlets, diffusion: "when emotional expression is blocked in any one region, outlet seems to take place somewhere else;" there is no conclusive evidence that the phenomena belong to the realm of the conditioned reflex. He also discusses consolidation among emotion, instinct and habit, the development of attitudes and the results of the physiological study of the emotions. The apparent conflict between the conception of emotion with its initial shock and chaos, paralysis and death-feint and the results of physiological observation which indicate "adaptive" processes is reconciled by the hypothesis that the better physiological state is due to the drug-like action of the autacoid substances; if small in amount, they are serviceable, if large, paralyzing. Moreover, the physiologists have overemphasized the adaptive character in all the major emotions. The immediate effect of an exciting stimulus is disruptive; there is a post-emotional state which may be mal-adaptive, but which may, on occasion, enhance the vital function. Sometimes, under a great tension, all part reactions hang together and mutually reinforce one another.

The James-Lange theory is still discussed and opinion is still divided. Larguier (7) expounds and defends James's view as a truthful introspective account of the content of emotion; Carver (1) rejects it on the ground of Sherrington's experiments, but is unable to decide between the alternatives that the corporeal concomitants are aroused along with the psychical excitement by the same stimulus, or that they are secondary to it; Ward (18) pronounces the theory to be "psychologically and biologically absurd"; Pillsbury (9) commits himself no farther than to say that "the vividness and life of the emotion depends upon the bodily expression" and that "the deep-seated motor response is an integral part of the emotion." His new chapter contains a good summary of recent work on the adrenals. Myerson (8), without knowing of the famous case reported years ago by Revault d'Allonnes, reports a similar one, but reaches no positive conclusion.

Warren (19, 20) makes a bold and original attempt at a classification of human reflexes, instincts and emotional phenomena on a purely empirical basis. The article was written preparatory to

the text-book, which shows some modifications, particularly in the arrangement of the reflexes. There is a list of from 60 to 70 of these, grouped under five heads. The instincts are divided into nutritive, reproductive, defensive, aggressive and social organization, the total number being 26. From these are distinguished the six instinctive tendencies, imitation, play, curiosity, dextrality, esthetic expression and communication. Human emotions are classified as expressive, reproductive, defensive, aggressive, social, and those with temporal—prospective or retrospective—projection; and under these headings 37 emotions are listed. Human dispositions are grouped under the same six heads, except that for the last is substituted instinctive and sentimental; 40 dispositions are named, each referred to its corresponding emotion. Finally, in the book, we have a classification of the sentiments as reality feelings, beliefs, esthetic, dynamic and moral, each of which is referred to its source. There is, of course, no claim for finality in a classification thus empirically constructed, and the classification presented seems to suffer from a certain lack of precision in the terms. In the article, for instance, there is no definition of emotion, and in the book it is only roughly defined as "a combination of systemic and motor elements." The author himself is of the opinion that no satisfactory catalogue of the emotions and dispositions will be reached until we are able to measure qualitatively and quantitatively the various secretory and metabolic changes which occur in the human system. Meanwhile it is something to have this patient and painstaking attempt at one.

The galvanometric indication of emotional phenomena is the subject of an experimental study by Waller (15). The best results were obtained on the palmar surfaces of hand and foot, suggesting a correlation with the presence of sweat glands. But neither atropin nor a rubber band rendering the limb pulseless and exsanguine appreciably affected the skin response. Disagreeably emotional ideas proved the most effective, more so even than the original experience; *e.g.*, the threat of a burn more than the burn itself.

A study of anger by Richardson (11) based on daily reports for three months of its casual occurrence in the experience of a number of persons, mostly students of psychology, though lacking in style, follows a sound method for the discovery of the pedagogical bearings of the emotion and contains some useful suggestions for the educator. The author points out the utility of anger in certain cases as well as the need and possibility of its control.

The account by Hoffmann (5), an air-plane pilot, of what went

on in his mind in the quarter of a minute or so in the descent of some 2,000 feet while guiding to safety his suddenly injured plane with a wing on fire, is a remarkable piece of introspective description. Besides the number and complexity of the ongoing processes perhaps the most striking feature of the experience was the calm supervening on and practically coincident with the initial fear and the immediate adjustment to the situation.

Portigliotti (10), examining the letters which passed between Abelard and Heloise thirteen years after the latter entered a convent and the former became a monk, attributes the coldness of Abelard as contrasted with the ardor of Heloise to his mutilation.

In a richly documented article, a chapter from a forthcoming book in three volumes, Janet (6), with accustomed finesse, analyzes the mental states and acts of neuropaths with special reference to their effects on the persons in the environment. The article is too long to summarize here, but the main contention is that certain persons, commonly considered odd or wicked rather than sick, exert an influence on those living with them which force the latter to maintain a higher degree of psychological tension than would otherwise be neeessary and by inducing fatigue tend to propagate the nervous disorder. To prevent this it often suffices to detect which is the dangerous person and to separate him from the rest.

The masterly discussion by Shand (13) should prove of unique interest to students of the psychology of value. Starting with the assumption that external things have value only so far as they are in actual or potential relation to some mind or minds, and that other things have value only so far as they are constituents or qualities of such minds, the problem is to find a theory consistent with this assumption and also with the common belief that things have a "real" value. The conclusion reached after an analysis which leads to the formulation of no fewer than eleven "laws" is as follows: "Intrinsic value is not a simple, statical quality. . . . It is essentially dynamical. It presupposes always something on which it can act, with which it has affinity, and the power of acting on this thing in certain ways. Such value, therefore, cannot be wholly contained in or confined to the thing which possesses it. For a condition of intrinsic value is the power of propagating the same kind of value in the other thing with which it has affinity. . . . Fear, anger and hate have one kind of effect; joy, admiration and love have an opposite kind. The power of each depends on its own nature. The power which is a condition of intrinsic value is therefore also conditioned by it."

The three historical articles by Gardiner (3, 4), based on a study of the sources, give a fairly full account of the affective psychology of the Greeks. They seem to show that while much has been learned, much also has been forgotten, and they tend to temper the assurance of progress in this field so easy to young students ignorant of what has been accomplished in the past.

REFERENCES

1. CARVER, A. The Generation and Control of Emotion. *Brit. J. of Psychol.*, 1919, 10, 51–65.
2. DRAKE, D. Is Pleasure Objective? *J. of Phil., Psychol. and Sci. Methods*, 1919, 16, 665–668.
3. GARDINER, H. N. The Psychology of the Affections in Plato and Aristotle. *Phil. Rev.*, 1918, 27, 469–488; 1919, 28, 1–26.
4. GARDINER, H. N. Affective Psychology in Ancient Writers after Aristotle. *Psychol. Rev.*, 1919, 26, 204–229.
5. HOFFMANN, C. G. Ordeal by Fire. A Note on the Psychology of Fear. *Atlantic Monthly*, 1910, 125, 353–356.
6. JANET, P. Les fatigues sociales et l'antipathie. *Rev. phil.*, 1919, 87, 1–71.
7. LARGUIER DES BANCELS, J. Instinct, Émotion et Sentiment. *Arch. de Psychol.*, 1919, 17, 153–186.
8. MYERSON, A. A Case of Altered Emotions Bearing on the James-Lange Theory. *J. of Abn. Psychol.*, 1918, 13, 239–249.
9. PILLSBURY, W. B. *The Essentials of Psychology*. (Rev. Edit.) New York: Macmillan, 1920.
10. PORTIGLIOTTI, G. Organi, funzioni e sentimenti. *Riv. di psicol.*, 1918, 14, 167–185.
11. RICHARDSON, R. F. *The Psychology and Pedagogy of Anger*. Educational Psychology Monographs. Baltimore: Warwick & York, 1918. Pp. 100.
12. ROGERS, A. K. The Place of Pleasure in Ethical Theory. *Phil. Rev.*, 1919, 28, 27–46.
13. SHAND, A. F. Emotion and Value. *Proc. Arist. Soc.*, 1919, N. S., 19, 208–235.
14. SPAULDING, E. R. Three cases of larceny in which the antisocial conduct appeared to represent an effort to compensate for emotional repression. *Mental Hygiene*, 1920, 4, 82–102.
15. WALLER, A. D. The Galvanometric Measurement of "Emotive" Physiological Changes. *Proc. Royal Soc.*, 1918, 90 (Ser. B), 214–217.
16. WALLIS, W. D. The Objectivity of Pleasure. *J. of Phil., Psychol. and Sci. Methods*, 1919, 16, 324–327.
17. WALLIS, W. D. What is Real Pleasure? *Ibid.*, 384–386.
18. WARD, J. *Psychological Principles*. Cambridge: University Press, 1919.
19. WARREN, H. C. A Classification of Reflexes, Instincts and Emotional Phenomena. *Psychol. Rev.*, 1919, 26, 197–203.
20. WARREN, H. C. *Human Psychology*. Boston: Houghton Mifflin , 1919.
21. WATSON, J. B. A Schematic Outline of the Emotions. *Psychol. Rev.*, 1919, 26, 165–196.
22. WILLIAMS, F. E. Anxiety and Fear. *Mental Hygiene*, 1920, 4, 73–81.
23. WILLIAMS, T. A. The Emotions and their Mechanism in Warfare. *J. of Abn. Psychol.*, 1919, 14, 15–26.

SPECIAL REVIEWS

The Physiological Basis of Thirst. W. B. CANNON (Croonian Lecture). *Proc. Roy. Soc.*, Series B, 1918, **90**, 283–301.

Professor Cannon shows that the "sensation" thirst is of local origin, depending necessarily upon stimulation of the nerves of the lining membrane of the mouth and pharynx. The immediate stimulus to thirst is the dryness of these membranes, and the psychology of such thirst would presumably be a perception of this dryness—at least Cannon sees no need to suppose that specialized nerves are involved and would therefore scarcely argue for a specific sensory quality. The usual cause of dryness of the mucosa of the mouth and pharynx is a lack of salivary flow, and, in the ordinary biological economy, the normal cause of decreased salivation is a diminution of the water-content of the body. The loss of water from the body by sweating may thus occasion thirst indirectly, since it decreases salivation and permits the mouth and pharynx partially to dry,—but the general bodily need of water is not the immediate stimulus to thirst. Conversely, an intravenous injection of water may quench thirst mediately by promoting salivation. Moreover the body may remain in need of water and thirst be abolished by a temporary moistening of the oral cavity; and the body may be well supplied with water, and thirst occur because of the drying of the lining membranes by continued passage of a stream of air through the mouth (prolonged talking or singing) or by the inhibition of salivation (anxiety or fright).

By the logic of this salivary mechanism Cannon is enabled to dispose of the theories that hold that thirst is a "sensation" of general bodily origin, and to avoid the implications of those experiments which show that thirst arises when the body has need of water and disappears when the need is satisfied even though no water is taken into the mouth. Normally a bodily need of water acts indirectly to cause dryness of the oral passages by decreasing the flow of saliva, but this need is not the immediate stimulus and is not associated with thirst if other means of moistening the mouth and pharynx are resorted to or if the mucosa of these passages is rendered insensitive by the use of a local anesthetic.

On the side of positive research Cannon contributes the results of experiments which show that thirst is usually associated with decreased salivation. He determined the amount of saliva secreted by chewing a tasteless gum at a uniform rate for five minutes, collecting and measuring all the saliva which flowed during this period. Thirst was induced both by deprivation of fluid food and by profuse sweating. Under both conditions salivary secretion was greatly decreased —from about three to one c.c. per min. in the case that is charted— and the onset of thirst coincided with the beginning of marked decrease. On taking water salivary secretion was soon restored to normal amount and thirst simultaneously abolished.

Cannon warns against the confusion of appetitive thirst with this sensory thirst. Both persons and animals drink from habit and association (appetite) when not thirsty, just they as eat from appetite when no longer hungry. Crude behavior can not be taken as an index of sensory thirst.

Many problems of bodily state during thirst are admittedly left untouched. There is also, the reviewer notes, the question of why a dry cold so instantly relieves thirst. Presumably, since a dry cold is the stimulus to the perception of wetness, it creates, in the presence of a dry mucosa, the illusion of wetness, thus indicating that the essential datum is the perception of dryness or wetness, and not the actual physical dryness or wetness of the tissues. So often the physiologist dealing with mental material like thirst stops just short of the essential fact.

Finally Cannon notes the place of thirst in the biological scheme. The removal of vertebrate organisms from an aqueous environment would require the development of a special mechanism for supplying the bodily need of water. Such a device is to be found, so Cannon observes, in the salivary mechanism. When the buccal cavities tend to dry artificially (*e.g.* in talking) salivation is increased reflexly. When, however, the body lacks water, salivary secretion, which is 97 per cent. water, can not be increased and thirst ensues. Thus thirst becomes an index of the water-need of the body. What Cannon does not tell and what all psychologists would like to know is how a sensory thirst comes to be invariably unpleasant and to act as a motive for a "voluntary" quest of water. It is this resultant questing, which unfortunately for Cannon's careful distinction has many factors common to appetite, that is fundamental to the survival value of thirst.

It is, in fact, in such manner that the interesting physiology of

Cannon's paper becomes contaminated by an unconvincing biology. Cannon seeks to exhibit a parallel between the three biological mechanisms by means of which the body is supplied with water, food, and oxygen, but he fails to see that the major part of the account of those mechanisms will be psychological. The parallel, as far as he goes, is plain in the case of thirst and hunger; both these are sensory affairs of local origin that indicate definite bodily needs and initiate "voluntary" quests for water or food. Of how the kinesthetic perception of stomachic contractions or of drying mucosa becomes the motive to specific action he has nothing to say.

The mechanism that provides against oxygen deprivation he asserts to be the action of carbon dioxide upon the respiratory center; but surely to appeal to a constantly operating unconscious reflex is not to create a parallel to conscious thirst and hunger. In the case of the oxygen-need we must turn for a parallel to asphyxiation, the "sensation" of "smothering" and possibly of "stuffiness." The conscious quest for oxygen arising upon a sensory perception of local bodily origin—the struggling of the smothered animal—is approximately parallel to the urges of hunger and thirst, but as little is known of this mechanism as has previously been known of the mechanism of thirst. This quest for oxygen is, moreover, as little like thirst as is the thirst of a fish on land. Cannon finds it "difficult to think of an animal living in water as experiencing thirst," yet seems ready to believe in an oxygen-thirst of the animal living in air. To the reviewer it seems that all these situations are biologically and psychologically comparable: the smothered man who perceives kinesthetically the distress of oxygen-deprivation, the hungry man who perceives kinesthetically his stomachic contractions, the thirsty man who perceives tactually the dryness of his buccal cavities, and the fish on land who perceives tactually the dryness of his tissues. All these perceptions mean something unpleasant and mean action, and the action is adequately adaptive according to the intelligence, experience, and habits of the subject. The fish out of water is thirsty, but less adequately so than the man out of drink. The biological problem is one of the psychology of action, and as such, we may note further, it includes the appetites as well as the "sensations."

EDWIN G. BORING

CLARK UNIVERSITY

Psychology of the Normal and Subnormal. H. H. GODDARD. New York: Dodd, Mead, 1919. Pp. xxiv + 341.

Dr. Goddard's new publication marks the end of ten years of service as Director of Research at the Vineland Training School. He describes his book as essentially a product of the Vineland laboratory. He believes that the presentation of the facts of mental processes as set forth is therefore in some respects different from that usually found, saying "We have been led to this point of view by the study of the feeble-minded; and have been confirmed in these views by the wide application they seem to have, not only to the feeble-minded but to many common phenomena of life."

The chapter headings do not depart strikingly from those of the standard text, but they are much reduced in number; and there is a consistent emphasis on the unity of mind. Although this unity has often been freely admitted, the present author, by cumulative argument and repetition, succeeds in driving the point home and in giving it significance. The very frequent and repetitive use of the neurone pattern as a means of describing and "explaining" the mental processes is partly inspired by his desire to emphasize the dynamic unity of the mind as a determining factor in human conduct. He also thinks it "highly desirable that the science of mind should be so formulated as to contribute to useful behavior." The neurone pattern plays a prominent part in Goddard's own formulations and gives the treatment a physiological, behavioristic turn. Herrick and James are the authors most freely quoted.

The chapters on the nervous system were carefully written and are unusually well illustrated. Several of the illustrations are not found in the standard texts. The autonomic nervous system is given much prominence. (Incidentally, attention may be called to an error in figure 16 which illustrates the possible length of various neurones. The cell body of the spinal sensory neurone is apparently represented as being the big toe.)

A second feature of the book is the treatment of the emotions. No new theory is advanced; but the importance of Mosso's and Cannon's views is shown. There are lengthy quotations from Cannon; and Mosso's address on "The Mechanism of the Emotions" at the Clark Decennial is reprinted in the Appendix. Is it altogether correct to say "that the James-Lange theory of emotions is true so far as it goes, but that it is only part of the story because it confines itself to the central nervous system and does not take into account the enormous part played by the sympathetic?"

(p. 138). James recognized not only the flood of sensations coming from the great body of muscles, but a long list of other bodily changes, involving the internal organs, and circulatory apparatus all controlled by the sympathetic system. Goddard, however, brings the contributions of various writers into relation; and provides a very useful discussion for the student. An original diagram illustrating McDougall's theory of the emotions is added (p. 142).

The subject of "Intelligence" receives considerable discussion. There are separate chapters on the relation of intelligence to will and to emotion. Intelligence is defined as "the summation of consciousness." "Conceived as an abstract mental process it is the sum total of all the related consciousnesses that one is able to bring to bear upon a particular occasion." There are some interesting reflections upon the relation of individual differences to Democracy and the sociological importance of recognizing various levels of intelligence. "The truest democracy is an institution for the feeble-minded, and it is an aristocracy,—a rule by the best."

The book does not attempt a systematic exposition of the psychology of the feeble-minded. There are chapters on Applications, The Determination of Mental Levels, Pedagogical Applications, Moral Training, etc., which deal directly with practical problems, with special reference to the subnormal; and the whole book is interspersed with concrete illustrations from life incidents among the feeble-minded; but there are no thorough-going psycho-clinical studies of either individuals or groups, and no effort to assemble such work from other investigators. The writer handles the psychology of normal and subnormal co-ordinately, illuminating the former by means of the latter. The aim is to aid the reader in the interpretation of human behavior, in general,—his own as well as that of others.

And the book fulfills its aim. Its chief merit is the very important one of *clearness*. The author has deliberately, by his consistent use of the neurone pattern concept, by means of summaries, illustrations, and lucid style, sought for clearness, "with the underlying thought that while there is no expectation that our formulation is the final truth, yet if we violate no known facts, our formulation will be helpful in proportion as it is clear." Dr. Goddard's book will be favorably judged by this criterion. It should be an illuminating introduction to the problems of human conduct, particularly to those for whom psychology has been too academic,

symbolistic, intangible. Whatever defects the neurone pattern concept may have, it helps to make the phenomena of human behavior tangible. For medical students, in particular, the book should be a good stepping stone.

Typographically, the volume is attractive, being set in large type, with a free use of section headings, italics, topical summaries, and illustrations. These features add to its effectiveness as a text. It is to be regretted that the book so completely annihilates the purchasing power of a five dollar bill.

ARNOLD GESELL

YALE UNIVERSITY

DISCUSSION

A NOTE ON THE SELECTIVENESS OF THE ACHROMATIC RESPONSE OF THE EYE TO WAVE-LENGTH AND ITS CHANGE WITH CHANGE OF INTENSITY OF LIGHT

BY C. E. FERREE AND G. RAND

Bryn Mawr College

In Dr. Troland's review of the article by us on this subject (PSYCHOL. BULL., **16**, 121) errors of statement occur on two important points. (1) "Unfortunately the writers do not speak of the size of field employed, so that one can not feel certain that strictly foveal stimulation was secured." The sizes of the fields employed are given on pp. 283 and 284, and again on p. 304, of the article reviewed. (2) "Ferree and Rand have made careful measurements of visibility curves at a number of intensity levels and find that the form of the curve varies radically with intensity even for intensity levels similar to those utilized in previous elaborate investigations by others. . . . The changes in visibility for certain wave-lengths due to intensity amount to many hnudred per cent." The form of our curves did not vary *radically* with intensity at the levels which have been used in recent determinations of standard visibility curves, meant to be independent of intensity. The differences at these intensities were significant but not radical. The radical differences were for much lower intensities 5 meter-candles and under. The impression certainly should not be left that the differences amount to many hundred per cent. at the higher intensities. It is doubtful if the Purkinje shift can be estimated in per cent from our data in the sense referred to by Troland. What was given in our tables was a comparison of the photometric and radiometric evaluations of our stimuli at the different intensities. The deviation of these from exact correspondence of ratio as the intensity was changed ranged for the different parts of the spectrum used from 10 to 21 per cent. for a change of 75 to 50 meter-candles; from 14 to 48 per cent. for 75 to 25 meter-candles; and from 16 to 50 per cent. for 75 to 12.5 meter-candles.

We are not aware of published results of "elaborate investigations of others" contradictory to our own. The recent belief that the Purkinje shift ceases at 25 meter-candles or thereabouts seems to refer back to statements made by Ives and Nutting. Ives claimed that at "approximately 25 meter-candles" (300 meter-candles falling on a pupillary aperture of 1 sq. mm.) the achromatic response is practically, if not entirely free from Purkinje effects; and Nutting, that an illumination of 350 meter-candles falling on a pupillary aperture of 1.465 sq. mm. is safely outside the range of the Purkinje effects. Neither man cites results in support of his claim. Moreover the photometric determinations in the work in which these statements occur were made by the flicker method; ours were made by the equality of brightness method, or as the eye normally sees its brightnesses. There are good physiological reasons, also experimental data, for not expecting agreement by the two methods. Helmholtz and others of the earlier writers (Chodin, *Sammlung phys. Abhandl. v. Preyer*, 1877, 1, p. 33, ff., Brücke, *Sitzungsber. der Wiener Akad.*, Math.-Natur. Klasse, 1878, (3), p. 63; etc.) believed that the eye changes its selectiveness of response to wave-length of light at the higher as well as at the lower intensities. This conclusion is drawn from a statement made by them that beginning with a spectrum of fully saturated colors and increasing the intensity of light, all the colors tend towards white and in so doing change their luminosities at different rates.

The question with regard to the intensity at which the Purkinje shift ceases, if at all, should be carefully studied before still more effort is expended on determining visibility curves meant to be used at 25 meter-candles and over.

A REJOINDER TO DRS. FERREE AND RAND'S NOTE

BY L. T. TROLAND

Harvard University

I have noted the objections raised by Drs. Ferree and Rand to the manner in which their paper on "The Selectiveness of the Achromatic Response of the Eye"[1] was treated in my review of the literature on vision for 1918. It would be extremely distasteful

[1] FERREE, C. E., and RAND, G. The Selectiveness of the Achromatic Response of the Eye to Wave-Length and Its Change with Change of Intensity of Light. *Studies in Psychology Contributed by Colleagues and Former Students of Edward Bradford Titchener*, Worcester, 1917, 280–307.

to me to have my yearly summary become the origin of any controversy, but it would seem that the authors above mentioned have decided upon an annual policy of reviewing my review, and it therefore appears necessary for me to reply in this particular case. It is my sincere purpose to make my reviews not only comprehensive but accurate, although the magnitude of the task involved in covering practically the entire literature on vision for any year is so great that I cannot hope to attain perfection in either of these regards. I also wish to state at the outset that I entertain a high degree of respect for the scientific ideals in the investigation of visual phenomena represented by the work of Drs. Ferree and Rand and certainly do not wish to disparage their researches. However, I cannot sympathize with their apparent feeling that their presentation of results is above criticism.

In their note these authors question the accuracy of my assertion that they neglected "to speak" of the size of the field which was employed in the work under consideration. A reëxamination of their original paper however, does not lead me to regard my criticism as an error. It is scarcely necessary for me to point out that the size of a visual stimulus field must be expressed either in terms of the angle subtended at the nodal point of the eye or in some linear measure of the image formed upon the retina. The investigations discussed in this paper were made with two quite different arrangements of apparatus, the arrangement for the first two series of measurements involving diffuse reflection of the spectral light, while that for the third series involved a concentration of the light from the spectrometer directly upon the eye of the subject. On pages 283 and 284 of the article the description of the conditions for the first *two* series includes a specification of the area of the surface thermopile which was employed and a statement that the photometric surface had the same area. This photometric surface, however, was placed normal to the beam of light falling upon it and therefore could not have been normal to the line of sight of the subject. Presumably it made an angle of 150 degrees with this line. It is not stated, however, whether any diaphragm was interposed between the photometric surface and the subject's eye or, if so, what the position of this diaphragm was. Furthermore, there is complete neglect to state the distance of the photometer head from the subject's eye. Without this latter data it is obviously impossible to calculate the size of the visual field involved, even on the basis of plausible assumptions.

The arrangement of apparatus for the *third* series of measurements is described on pages 303 to 305 of the original article *following* the presentation of the data obtained by its use, and consequently in a position where it is apt to be overlooked or misinterpreted by the reader. It is stated that "a screen, S, containing a stimulus opening 15 mm. in diameter" was employed, this screen being placed "20 cm. from the eye." Assuming the "stimulus opening" to be a circle, we can compute from these data the size of the stimulus field which I find to be 4.28 degrees in diameter. The experimental arrangement in this case, however, is not sufficiently simple to make it easy for one not well acquainted with the properties of optical systems to feel confident of the meaning of the various distances and sizes which are specified.

In the case of the second arrangement of apparatus, just discussed, Drs. Ferree and Rand may feel that I am laying undue stress on their failure to reduce the statement of the stimulus conditions to terms of visual angular dimensions. It is therefore necessary for me to enlarge somewhat upon the significance of this oversight on their part. The investigations under consideration are concerned with a change in form of the visibility or achromatic sensitivity curve of the eye, conditioned by changes in the intensity of the stimulus. It is a truism of visual psycho-physiology that two radically different curves of this sort are involved in the visual function, one representing the response of the visual system based upon the retinal cones and the other that of the system innervated by the retinal rods. It is also a truism that the rods are absent from a small area of the central retina but that in practically all other parts of the retina both rods and cones are present in varying proportions. The rod-free area is specified by Parsons[2] as being ordinarily 3 degrees and 3 minutes, or 3.05 degrees in diameter. The visual angular diameter of the field employed by Drs. Ferree and Rand in their second experimental arrangement was apparently 1.23 degrees greater in diameter than the rod-free area. They were therefore apparently dealing with a combination of rod and cone vision, and variations in the form of the resultant visibility curve were to be expected at intensities at which rod vision plays an appreciable rôle. The writers may disclaim an interest in the theoretical development or implications of their results, but it would seem that these results lose most of their significance because of the fortuitous combination of rod and cone vision which they

[2] Parsons, J. H., *An Introduction to the Study of Colour Vision*, 1915. p. 10.

involve. As for the first two series of measurements, we are seemingly quite without means of determining the dimensions of the retinal area which was employed.

I find upon reëxamining their paper that Drs. Ferree and Rand have not only neglected the question of the angular size of the visual stimulus field employed but have omitted to specify other conditions which are of great importance for any theoretical interpretation of their results. For example, they do not state what point of the field was fixated, or whether any attempt was made to maintain fixation constant. For the first two series of measurements they also fail to specify either in photometric or radiometric units the absolute intensities of the stimuli which were employed. They provide us with a value for the candle power of the lamp which was used but do not give the distances of this lamp from the photometric surface for any experimental setting. They also do not specify the efficiency (candles per watt) at which the lamp was burned, a condition which it is necessary to know to determine the integral color of the corresponding portion of the photometric field. For the second arrangement of apparatus the efficiency is specified, but in this case a different lamp was employed.

In addition to these omissions I find no reference to the conditions of adaptation of the subjects' eyes during the experiments. This is an item of great importance for the form of a rod-cone visibility curve, since it is a well known fact that the degree of participation of rod vision in the total visual response depends as much upon the state of adaptation of the rods relative to that of the cones as upon the level of intensity of the stimulus. I am also disappointed to find no statement of the number of subjects employed and whether they were known to have normal vision. The tables provide us with data often carried out to four, and sometimes five, significant figures but with no other method of determining the precision of the data. Judging from the smoothness of the curves a considerable number of measurements must have been made for each point.

Another omission which seems to me worth mentioning is the absence of a specification of the exact wave-length ranges of the spectral stimuli which were employed. The width of the analyzing slit is given in ten-thousandths of a millimeter, but that of the collimator slit is entirely omitted. The considerable width of the analyzing slit "0.5575 mm.," suggests that the wave-length ranges were by no means negligibly small, but we have no means of deter-

mining to what portion of these ranges the single wave-length values which are given refer. Presumably if they are values taken from a calibration plot they refer to one end of the ranges in question, and it is a matter of considerable significance for the interpretation of the results to know which end is actually represented.

A second statement in my review to which Drs. Ferree and Rand take exception is one in which I assert that according to their findings "the form of the [visibility] curve varies radically with intensity even for intensity levels similar to those utilized in previous elaborate investigations by others." They object to the use of the term "radically." An argument over this particular point would probably reduce itself to a philosophical debate concerning the meaning of the word "radical." "The elaborate investigations" which I had in mind were the visibility determinations made by Ives[3] with 18 subjects, by Nutting[4] with 21 subjects, and by Coblentz and Emerson[5] with 130 subjects. As a reference to my reviews for 1917 and 1918 will show, a considerable number of investigators have recently determined average visibility curves, using a large number of subjects. The purpose has been in every case to ascertain the constant function connecting the luminosity response of the retinal *cones* with the wave-length of the stimulus. The intensity conditions employed by the three investigators mentioned above were as follows:

Investigator	Ives	Nutting	Coblentz & Emerson
Reflecting surface	MgO at 90°	MgO (?) at 63° (?)	MgO at 90°
Illumination (M. C.)	25	350	50
Brightness (C/M^2)	6.86	85.7	13.74
Pupil (sq. mm.)	12 (nat.)	1.465 (art.)	1.368 (art.)
Photon value	82.4	125.6	18.78
(Field Size)	2°	?	2°

I have reduced the intensities to terms of my "pet" unit, the photon (brightness of the stimulus in candles per meter^2 multiplied by the area of the pupil in square millimeters), which is proportional to the illumination value of the retinal image, the actual visual stimulus. The intensities in question lie between approximately 20 and 125 photons.

[3] Ives, H. E. Studies in the Photometry of Lights of Different Colors. V. The Spectral Luminosity Curve of the Average Eye. *Phil. Mag.*, 1912, 24, 853–863.

[4] Nutting, P. G. The Visibility of Radiation. *Phil. Mag.*, 1915, 29, 301–309.

[5] Coblentz, W. W. and Emerson, W. B. The Relative Sensibility of the Average Eye to Light of Different Colors and Some Practical Applications to Radiation Problems. *Bull. of the Bur. of Stand.*, 1918, 14, 167–237.

In order to reduce the intensities employed by Drs. Ferree and Rand to the same terms it is necessary to know the sizes of the natural pupil for the stimulus conditions which they used. Nutting, Blanchard and others give normal pupil areas at various brightnesses for large stimulus fields but not for small fields. However, I have found the problem sufficiently interesting to warrant a determination of the pupil sizes for my own eye under conditions of field size and brightnesses exactly similar to those utilized by Drs. Ferree and Rand. My results for the 75 and 12.5 M.C. cases were 13.4 and 13.2 sq. mm. with complete daylight adaptation, and 15.6 and 25.3 sq. mm. respectively after 12 minutes complete dark adaptation. Assuming the conditions of Ferree and Rand's work to correspond roughly with the latter pair of figures, we find their highest and lowest intensities to be 321.5 and 87.0 photons respectively. The lower value is practically the same as that which obtained in Ives' work.

Now all three of the investigators whose results I am comparing with those of Drs. Ferree and Rand assume, and indeed assert, that the intensities which they employed were safely above the range of the Purkinje effect. Ives found "comparative fixity" in the form of the curve from "70 I.U." (= 19.2 photons) up.[6] Nutting tried intensities 1/2, 1/4, 1/16 of his standard value without detecting any Purkinje shift at these intensities. Coblentz and Emerson satisfied themselves by preliminary work between 25 and 780 M.C. (9.38 to 292.6 photons) that results obtained at 50 M.C. (18.78 photons) would be representative of daylight vision. Upon examining Table VIII of the paper by Drs. Ferree and Rand I note that between their limiting values of 75.0 and 12.5 M.C. (321.5 and 87.0 photons respectively) they found a change in "visibility" of the red stimulus (660 $\mu\mu$) relative to the yellow-green (560 $\mu\mu$) from 5.87 to 10.54. This is an increase of 79.5 per cent. Whether or not this is a "radical" change I must leave to the reader's judgment.

Drs. Ferree and Rand object to my statement that "the changes in visibility for certain wave-lengths due to intensity amount to many hundred per cent." Here, again, the validity of the statement depends upon the method of reasoning. A change estimated

[6] Ives, H. E. Studies in the Photometry of Lights of Different Colors. I. Spectral Luminosity Curves Obtained by the Equality-of-Brightness Photometer and the Flicker Photometer Under Similar Conditions. *Phil. Mag.*, 1912, 24, 149–188. Especially pp. 170–172.

as in excess of 100 per cent., has obviously been treated as an increase and not as a decrease. The results in Table I in the article reviewed show a visibility value of the red stimulus relative to the yellow-green of 0.015/0.777 = .0193 for the intensity, "1/12 *A*," while for the intensity, "*A*," the same ratio is 0.98/4.02 = .244. If regarded as a percentage increase with respect to the lower value this is a change of 1164 per cent. I do not feel that my original statement implies that changes as great as this occurred at "intensity levels similar to those utilized in previous elaborate investigations by others."

If it were not for the fact that the field employed by Drs. Ferree and Rand was considerably larger than those used by the other investigators there would certainly appear to be a contradiction between the results of the former and of the latter. I do not believe that the appeal of the first-mentioned investigators to the difference between the flicker and the equality-of-brightness methods helps their case very much. Ives used both methods, and Purkinje effects (reverse effects) appear in the former me hod under the same conditions which produce them in the method of direct photometric comparison. In this connection it is worth noting that Drs. Ferree and Rand have neglected to criticize my review at one point where my remarks can correctly be accused of inadequacy, *viz.*, my statement that the change in the form of the visibility curve indicated by their results is of the familiar Purkinje type. This holds good of the first two series of measurements, but not of the third, the series which we have just been discussing. The results in this series indicate a *reverse* Purkinje effect, since there is an increase in the visibility of the red stimulus relative to the blue. The reverse effect, as indicated by the values which are given, is a strong one. This is a very surprising finding, and one which is certainly contradictory not only to the quantitative work of Ives and others but also to a multitude of qualitative demonstrations of the manner in which the distribution of luminosity in the spectrum alters with decrease in intensity.

It occurs to me that the explanation of this anomalous finding may possibly lie in the nature of the *pupillary* conditions which obtained for the third series of measurements reported by Drs. Ferree and Rand. These conditions were such as to make the luminous flux reaching the retina from the "white" comparison field dependent upon the area of the natural pupil, while that from the spectral field was not thus affected, since the latter was con-

centrated wholly within the natural pupil in the form of an image of the spectrometer slit. Alterations in the size of the subject's pupil would therefore alter the relative apparent brightnesses of the two fields independently of any other causes. (I have often used this principle as a convenient method of determining pupillary areas.) Progressive changes in the area of the natural pupil are to be expected in the course of a series of measurements, unless considerable care is taken to insure equilibrium conditions of adaptation. Moreover, the pupillo-motor values of equally bright lights at low intensities and in large fields are probably not equal, since the work of Hess and others[7] indicates that control of the pupil is based mainly upon cone response. This would entail a relatively smaller pupil for the red end of the spectrum, as compared with the blue end, at the lower intensities. It would have the effect, under the conditions of Drs. Ferree and Rand's measurements, of decreasing the physical intensity of the red stimulus required to match the "white" comparison stimulus, more rapidly—with a general decrease in intensity level—than that required for the blue. Although this expectation corresponds with the results which they obtained, I do not insist that my explanation is the correct one.

[7] See, e.g. ENGELKING, E. Der Schwellenwert der Pupillenreaktion und seine Beziehungen zum Problem der pupillomotorischen Aufnameorgane. *Zeitsch f. Sinnesphysiol.*, 1919, 50, 319–337.

COMMUNICATION

PSYCHOLOGICAL TERMINOLOGY

The Committee on Terminology of the American Psychological Association is taking up for examination terms in the fields of Sensation and Cognition. Psychologists interested in the precise use of terms are invited to assist the Committee in its work by calling the chairman's attention to—

(1) Psychological terms used with two or more different meanings (whether distinguished or not), and terms used indefinitely or ambiguously in contemporary writings.
(2) Pairs or groups of terms which lead to confusion when used interchangeably.
(3) Foreign terms needing definition or translation.
(4) Books and articles containing systematic lists of cognate terms, or discussions of ambiguous terms. (Full references desired.)

It is a matter of prime importance in any science to clear up double meanings and imperfect synonyms. The word *feeling* is used in standard psychological works with several different meanings. The words *intellect* and *intelligence* are used by some writers interchangeably, while others draw a sharp distinction between them. There are many instances in the literature of both kinds of confusion.

The Committee wishes to include a large number of such terms in its next report, either defining and distinguishing them or citing discussions in easily accessible sources. This list will not be confined to sensation and cognition, but will cover the entire field of psychology. Will readers of this magazine assist the Committee to make the list fairly complete?

HOWARD C. WARREN, CHAIRMAN,
Princeton University

PRINCETON, N. J.,
February 9, 1920

BOOKS RECEIVED

EVANS, E. *The Problem of the Nervous Child.* New York: Dodd, Mead, 1920. Pp. viii + 299. $2.50.

DUNLAP, K. *Personal Beauty and Racial Betterment.* St. Louis: Mosby, 1920. Pp. 95. $1.00.

VAUGHAN, V. C. *Sex Attraction.* St. Louis: Mosby, 1920. Pp. 44. $.50.

School and Home. New York: Parents and Teachers Association, Ethical Culture School, 1920. Pp. 33.

PARTLOW, W. D. & HAINES, T. H. *Mental Rating of Juvenile Dependents and Delinquents in Alabama.* Jackson; Miss.: Nat. Comm. for Mental Hygiene. Pp. 292–309.

Journal of Educational Research. Urbana, Univ. of Illinois: B. R. Buckingham, Editor. $3.00.